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ABSTRACT

The authors summarize results of their own and others' research of auditory language processing deficits associated with learning disabilities in children and adolescents. Among findings reported are that learning disabled children exhibit delays in the acquisition of morphological and syntactic rules, delays in logical growth, short-term memory deficits for verbal materials, and heavy dependence upon semantic aspects in language processing. (Author/LS)

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LANGUAGE PROCESSING DEFICITS IN LEARNING DISABLED CHILDREN AND ADOLESCENTS

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Language processing deficits associated with learning disabilities were recognized early in the history of the field (Borel-Maisonny, 1951; Cruickshank et al., 1961; Myklebust, 1954; Orton, 1937; Strauss & Kephart, 1955). Recognition of the significance of auditory language deficits has stimulated investigation of their nature and extent (McGrady & Olson, 1970; Rosenthal, 1970; Semel & Wiig, 1974; Vogel, 1973; Wiig & Roach, 1974; Wiig & Semel, 1972, 1973, 1974; Wiig et al., 1973). The present paper will focus on investigations of aspects of auditory language processing abilities of learning disabled children and adolescents by the present investigators. Recognizing that the auditory processing deficits associated with learning disabilities cover a wide range, the paper considers only aspects of auditory processing of higher-level language. The following language processing abilities were investigated in learning disabled children and/or adolescents: (1) comprehension of critical word sequences and syntactic structures, (2) knowledge and comprehension of English morphology, (3) comprehension of linguistic concepts requiring logical operations, and (4) immediate recall of semantically and syntactically varied sentences.

Semel and Wiig (1974) compared the comprehension of critical word sequences by 7 to 11 year-old learning disabled and academically achieving children, using the Assessment of Children's Language Comprehension (Foster et al., 1973). The experimental task required analysis and synthesis of critical word sequences with from two to four elements as in the sequence "Monkey sitting on fence." The performances by the academic achievers indicated

a ceiling effect. In comparison, the performances by the learning disabled children were similar to those reported for 6 to 6 1/2 year-olds in the normative data (Table 1).

The learning disabled children also demonstrated significant deficits in the comprehension and expression of syntactic structures on the Northwestern Syntax Screening Test (Lee, 1969)(Table 1). Individual test scores by the learning disabled children were compared with normative data either for the appropriate age level or for the highest age level for which norms were available. The comparison indicated that 76% of the learning disabled children scored below the 10th percentile and 85% below the 25th percentile on the Receptive subtest of the NSST. This finding assumes educational significance when related to the statement that younger children scoring below the 10th percentile warrant in-depth language evaluation and language training (Lee, 1969).

(Insert TABLE 1 about here.)

The responses by the learning disabled children to the ACLC test items with four critical verbal elements indicated that the highest relative percentages of errors occurred for items which contained the prepositions "over" and "behind." Analysis of the errors according to the position of the verbal element which was incorrectly processed indicated that 66.7% of all errors involved the 2nd and 3rd verbal elements in the sequence, suggesting reductions in short-term memory and simultaneous analysis and synthesis (Miller & Chomsky, 1963; Slobin, 1971).

Error patterns by the learning disabled children on the NSST indicated that sentences considered to be of higher grammatical

complexity, such as question sentences, sentences with demonstratives and 'wh' forms, possessive relationships, and relationships between direct and indirect objects, were most discriminating. The findings suggested that learning disabled children exhibit quantitative delays in the acquisition and comprehension of syntax. They concurred with previous observations of syntactic deficits in children with delayed language (Menyuk & Looney, 1972).

In a related study, Wiig, Semel, and Crouse (1973) investigated high-risk and learning disabled children's knowledge of English morphology. High-risk and learning disabled children were observed to share problems in applying morphological rules to the nonsense and real words of Berko's experimental test of morphology (Berko, 1958). Both groups exhibited delays in the acquisition of specific morphological rules and shared the greatest relative deficits in forming the third person singular of verbs, noun possessives, and adjectival inflections when compared with age peers. It was concluded that learning disabled children exhibit quantitative delays in the acquisition of morphology when compared with achieving age peers. In research with adult aphasics, Goodglass and Hunt (1958) established that the severity of aphasia was predictive of defisits in forming noun possessives. The inference can therefore be made that the knowledge of morphology relates directly to the language processing ability of the learning disabled child.

The English language contains a variety of linguistic concepts in which logical relationships are expressed between two or more verbal elements. Among the linguistic concepts are sentences which express (1) comparative relationships, (2) passive relationships,

(3) spatial relationships, (4) temporal relationships, and (5) familial relationships. These linguistic concepts were selected for comparison of logico-grammatical sentence comprehension by 32 learning disabled and 16 academically achieving children ranging in age from 7 yr. 4 mos. to 11 yr. 4 mos. Learning disabled children exhibited significant quantitative deficits in the comprehension of these linguistic concepts. They demonstrated most errors in comprehending familial relationships, followed in decreasing order of difficulty by spatial relationships, temporal relationships between sequential events, passive relationships, and comparative relationships (Table 2).

(Insert TABLE 2 about here.)

Developmental data obtained from 210 children in Grades 1 through 8 have indicated significant increases in the comprehension of comparative, passive, spatial, temporal, and familial relationships during the age range from 7 to 11 years (Wiig & Semel, 1974). Grade school children demonstrated increasing ability to interpret these linguistic concepts until about age 11. Between ages 11 and 13 their comprehension of these logico-grammatical sentences remained stable (Table 3).

The developmental data suggested a hierarchy of difficulty for the linguistic concepts which concurred with that demonstrated by learning disabled children (Wiig & Semel, 1973). In relation to models of logical growth, the normal comprehension of logico-grammatical sentences improved throughout the "concrete operational" level of development (Inhelder & Piaget, 1964; Piaget & Inhelder, 1969). The stabilization in the comprehension of the selected

linguistic concepts occurred during an age period which concurs with the period of normal transition from the "concrete operational" to the more abstract "formal operational" level of development.

According to models of logical growth, learning disabled children demonstrated evidence of comprehending familial relationships at "sensorimotor" or "pre-operational" levels (Inhelder & Piaget, 1964; Piaget & Inhelder, 1969). They assigned proper names for family members or gave stereotyped responses. The learning disabled children gave the largest number of correct responses to linguistic concepts expressing comparative relationships. This finding concurs with observations by Piaget and Inhelder (1969) that seriation of two non-verbal elements occurs early at the "sensorimotor" level of development. Their responses to passive constructions suggested that they retained the sequence of the critical verbal elements but failed to process for the linguistic structure. The learning disabled children also showed reductions in the comprehension of spatial and temporal relationships which suggested persisting pre-operational cognitive and logical processes (Piaget & Inhelder, 1969).

Goodglass and Kaplan (1972) have noted that the discrimination and interpretation of familial relationships depend entirely upon word order. Error responses by learning disabled children to familial relationships have suggested that one aspect of the concept, the last noun, assumes primary importance and that simultaneous analysis and synthesis may not occur.

Wiig and Semel (1974) established that comprehension deficits

for linguistic concepts expressing comparative, passive, spatial, temporal, and familial relationships persist in an adolescent population with learning disabilities. The problems experienced by both learning disabled children and adolescents are considered to reflect impairments of abstraction and generalization and of simultaneous analysis and synthesis and delays in logical growth (Goodglass & Kaplan, 1972; Inhelder & Piaget, 1964; Luria, 1966; Mecham et al., 1966; Piaget & Inhelder, 1969).

The effects of varying the semantic and syntactic constraints on the recall of sentences by learning disabled adolescents were recently investigated by Wiig and Roach (1974). They administered Newcombe and Marshall's experimental sentences (Newcombe & Marshall, 1967) to 30 learning disabled and 30 academically achieving adolescents matched for sex, age (between 12 yr. 5 mos. and 16 yr. 4 mos.), IQ, and receptive vocabulary. The learning disabled adolescents recalled significantly fewer of the sentences verbatim than the academically achieving adolescents. They made significantly more errors than the achievers on (1) sentences which were syntactically well formed, but violated semantic (selectional) rules, e. g., "The sky that the dream thought jumped cheaply," (2) sentences which contained correctly or incorrectly sequenced modifier-strings, e. g., "She has washed plastic red small eight cups," (3) a sentence which contained a random word-string, e. g., "Walk some by hard of clearly table very," and (4) a structurally complex sentence with 'embedding,' e. g., "The burglar that the police found escaped easily" (Table 4).

(Insert TABLE 4 about here.)

The findings suggested that the significant variables in sentence recall by learning disabled adolescents were semantic consistency and syntactic complexity. This finding is at variance with observations that sentence length and structure comprise the significant variables for sentence recall by children with delayed language development (Menyuk & Looney, 1972). It agrees with observations by Newcombe and Marshall (1967) that adult aphasics with left hemisphere lesions experienced the most marked deficits in immediate recall for sentences which violated semantic (selectional) rules, contained random word-strings, or provided the possibility for semantic confusion. Perseveration of linguistic materials, either intra- or inter-sentence, also seemed to provide a significant interference with the processing abilities of the learning disabled adolescents.

The responses by the learning disabled adolescents to the most discriminating sentences were characterized by word omissions and word substitutions, indicating inadequate recall of specific words. They also normalized deviant syntactic structures less frequently than the academically achieving adolescents, suggesting that they did not attempt to "code" the material in terms of linguistic structure. When the learning disabled adolescents substituted words, they were within-class and similar to word substitutions demonstrated by dyslexic children in oral reading (Kolers, 1972). According to theories of memory for linguistic materials (Miller & Chomsky, 1963; Slobin, 1971), the data suggest that the reductions in sentence recall by learning disabled adolescents reflect limitations in short-term memory and that deep

structure and semantic interpretation, represented in long term memory, facilitate auditory processing and recall.

The findings are considered to have implications for the assessment and management of language processing deficits associated with learning disabilities. Recognition of delays in the acquisition of morphological and syntactic rules, delays in logical growth, short-term memory deficits for verbal materials, and heavy dependence upon semantic aspects in language processing may result in more efficient remedial strategies.

It is evident from our research of auditory language processing deficits associated with learning disabilities that several areas remain to be investigated further. Areas which appear to merit future investigation relate to the comprehension of prepositions and prepositional phrases, negations, adjectives, and modifier-strings by learning disabled children and adolescents. Investigations should also consider the "channel capacity," i. e., the amount of information that can be handled at any one time, the number and the size of "chunks" which can be held in short-term memory store (Miller, 1956; Newell & Simon, 1972; Simon & Chase, 1974), and the relationships between visual perception, linguistic and cognitive processing, and "channel capacity" and "chunking" characteristics of learning disabled youngsters.

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TABLE 1. Summary of scores obtained by 34 children with learning disabilities and 17 achieving controls on the NSST and ACLC.

Test	Mean		Standard deviation	
	LD	Controls	LD	Controls
NSST:				
Receptive	31.38	37.71	5.87	1.20
Expressive	29.47	38.59	9.85	1.23
ACLC:				
Vocabulary	49.26	50.00	1.22	0
2 elements (%)	97.35	100.00	6.09	0
3 elements (%)	92.06	98.82	7.58	3.33
4 elements (%)	77.06	98.24	15.62	3.69

TABLE 2.

Mean number of comprehension errors for the logico-grammatical sentence test by 32 learning disabled and 16 achieving children.

Subtest	Learning disabled	Achievers	t
Total test	16.66	5.81	8.82*
comparative relationships	1.50	0.50	-
Passive relationships	2.56	1.44	-
Temporal relationships	3.13	1.75	-
Spatial relationships	4.70	1.56	-
Familial relationships	5.00	0.56	-

* $p < .001$.

TABLE 3.

Correct responses to logico-grammatical sentences by 210 grade school children by grade (nS = 30)

Relationship		Grade						
		1	2	3	4	5	6	7-8
Total test	M	26.30	34.90	37.13	41.06	45.40	46.97	46.27
	SD	4.99	4.76	6.14	3.99	3.86	2.06	2.00
Comparative	M	7.70	8.10	8.50	8.67	9.47	9.60	9.40
	SD	1.55	1.33	1.28	1.38	0.72	0.61	0.55
Passive	M	6.60	7.80	7.83	8.37	8.67	9.17	9.00
	SD	1.43	1.64	2.03	1.28	1.47	0.90	1.03
Temporal	M	6.50	6.53	6.77	7.60	8.73	9.07	8.73
	SD	1.50	1.83	1.75	1.33	1.41	0.82	0.99
Spatial	M	4.73	7.23	8.13	8.60	9.17	9.43	9.27
	SD	2.06	1.52	1.43	0.99	1.10	0.92	0.73
Familial	M	1.43	5.23	5.97	7.83	9.07	9.70	9.87
	SD	1.50	2.92	2.98	2.68	2.21	0.74	0.43

TABLE 4. Comparison of Verbatim Repetitions by 30 Learning Disabled Achieving Adolescents.

"Sentence"	Learning Disabled	
	No.	%
1. The team of workers built the bridge.	30	100.0
2. Colorless green ideas sleep furiously.	16	53.3
3. The man posted the letter.	30	100.0
4. The boy hit the girl.	30	100.0
5. The politician nearly lost the election.	27	90.0
6. The boy easily passed the examination.	28	93.3
7. Didn't the mechanic repair the van?	26	86.7
8. Didn't the lion chase the tiger?	30	100.0
9. Wasn't the stone wall built by the kind husband?	29	96.7
10. Wasn't the rich uncle advised by the nice manager?	16	53.3
11. She has bought five large brown leather cases.	13	43.3
12. He has sold the long heavy grey shiny car.	11	36.7
13. She has washed plastic red small eight cups.	5	16.7

parison of Verbatim Repetitions by 30 Learning Disabled and 30 Academically lescents.

	Learning Disabled		Achievers		χ^2
	No.	%	No.	%	
of workers built the bridge.	30	100.0	30	100.0	0
green ideas sleep furiously.	16	53.3	26	86.7	7.16**
sted the letter.	30	100.0	30	100.0	0
t the girl.	30	100.0	30	100.0	0
cian nearly lost the election.	27	90.0	30	100.0	2.19
sily passed the examination.	28	93.3	30	100.0	1.16
mechanic repair the van?	26	86.7	30	100.0	3.28
lion chase the tiger?	30	100.0	30	100.0	0
stone wall built by the kind husband?	29	96.7	30	100.0	0.72
rich uncle advised by the nice manager?	16	53.3	23	76.7	3.09
ught five large brown leather cases.	13	43.3	24	80.0	7.77**
d the long heavy grey shiny car.	11	36.7	16	53.3	1.36
shed plastic red small eight cups.	5	16.7	15	50.0	6.77**

TABLE 4. Continued.

"Sentence"	Learning Disabled	
	No.	%
14. Not in a tree to the lake ran with.	8	26.7
15. Walk some by hard of clearly table very.	5	16.7
16. The sky that the dream thought jumped cheaply.	14	46.7
17. The burglar that the police found escaped easily.	24	80.0
18. The chair roughly painted the fire.	27	90.0
19. Wasn't the fat ceiling robbed by the tired pen?	16	53.3
20. The man that the book read was interesting.	25	83.3

* $p < .05$; ** $p < .01$; *** $p < .001$.

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	Learning Disabled		Achievers		χ^2
	No.	%	No.	%	
tree to the lake ran with.	8	26.7	13	43.3	1.18
e by hard of clearly table very.	5	16.7	13	43.3	4.46*
that the dream thought jumped cheaply.	14	46.7	26	86.7	9.92**
lar that the police found escaped easily.	24	80.0	30	100.0	5.60*
r roughly painted the fire.	27	90.0	30	100.0	2.19
he fat ceiling robbed by the tired pen?	16	53.3	28	93.3	11.27***
that the book read was interesting.	25	83.3	30	100.0	4.42*

** $p < .01$; *** $p < .001$.